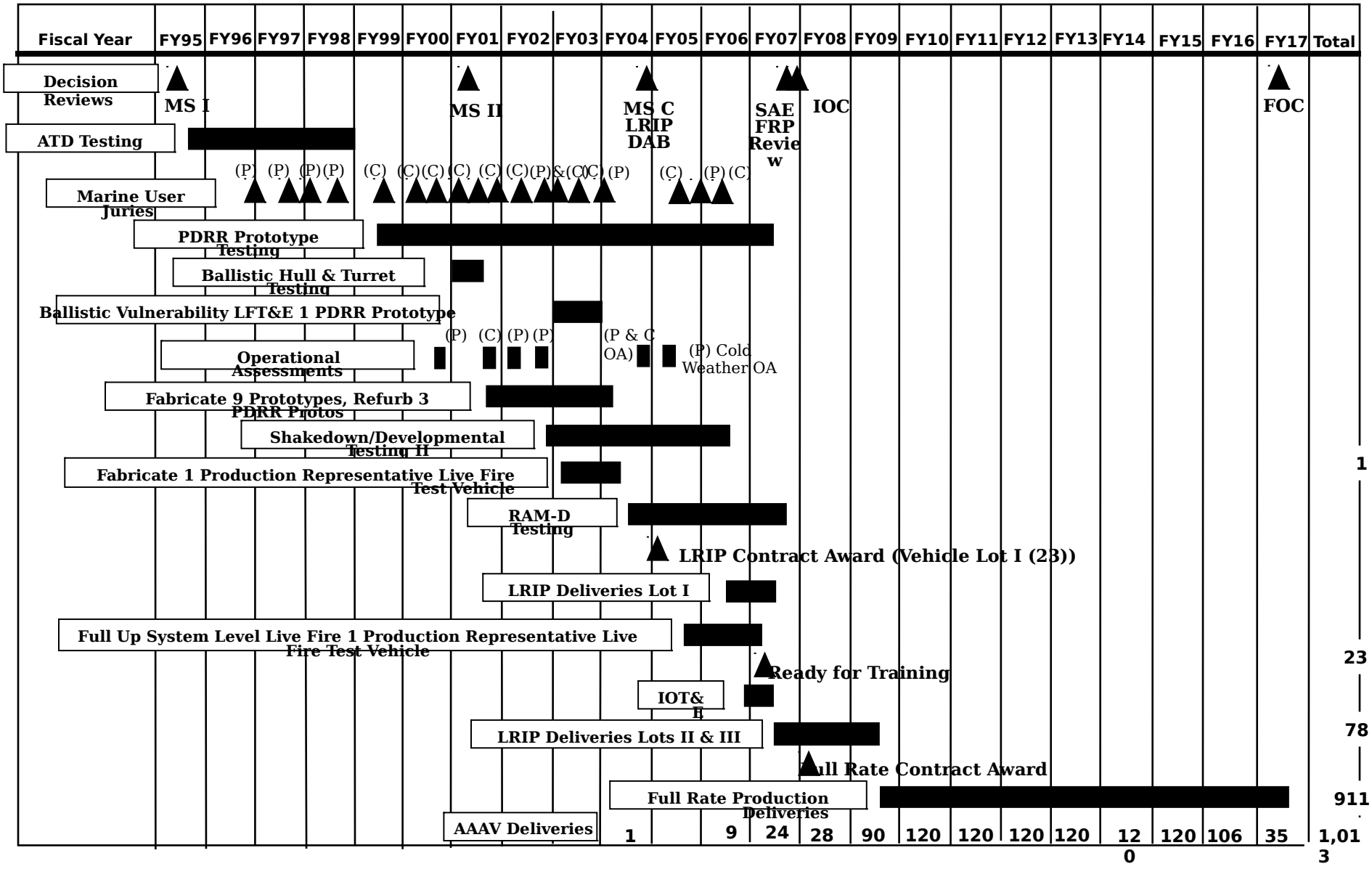
ADVANCED AMPHIBIOUS ASSAULT VEHICLE

6 February 2002

AAAV PROGRAM SCHEDULE

6 February 2002



AAAV TESTING STRATEGY

Concept Exploration

Hydrodynamic Test Rig

Automotive Test Rig

Technology Demonstrators

Program Development and Risk Reduction

- **USER Juries**
- **Combined Arms Exercise**
- **Force on Force Modeling**
- **Logistics Demonstrators**

Integrated Functionality

System Development and Demonstration

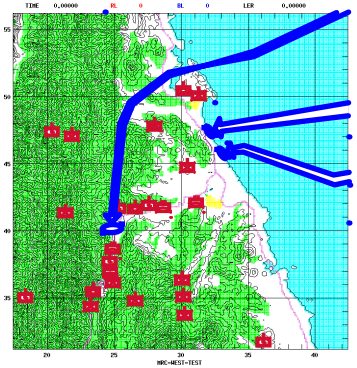
- **9 Vehicles**
- **SDD OA**
- **Cold Weather O**
- **RAM-D Testing**
- **IETM Validation**

Verification

Multi-Vehicle Operations Operational Suitability

Production Readiness and Low Rate Initia Production

- **IOT&E**



FUSL IOT&E Test to Prove

TESTING HIGHLIGHTS

- Land Testing - 3,659 Miles
- Water Testing - 1,913 Hours
- Firepower Testing
- Ballistic Hull & Turret Survivability Testing
- C4I Testing
- AAAV (P) and AAAV(C) EOA
- Logistics Demonstration (Training & Maintenance
- IETM Demonstration
- User Juries

AAAV(P) & (C) USER JURIES

- **User Jury I –** AAAV(P) GDAMS Existing Technology Demonstration: Oct 28-29, 1996
- **User Jury II –** AAAV(P) Crew Station Mapping And Navigation Displays, Interactive Electronic Technical Manual (IETM), And Programmable Pushbutton Switches Demonstration/Evaluation: Apr 16-18, 1997
- **User Jury III –** AAAV(P) Human Factors Engineering: Oct 22-24, 1997
- **User Jury IV –** AAAV(P) Troop Arrangements and Egress: May 18-22, 1998
- **User Jury V & VI –** First AAAV(C): May 99 and June 99; Second AAAV(C): Feb 2, 2000
- **User Jury VII –** Third AAAV(C): Seating Arrangements and Egress: Aug 29-30, 2000
- **User Jury VIII** - Fourth AAAV(C) Mobile Operational Prototype: Sep 19-21, 2000
- **User Jury IX –** Fifth AAAV(C): Human Factors Engineering and Ergonomics: April 23-26, 2001
- **User Jury X** - Sixth AAAV(C): Mobile Operational Prototype II: 20-31 Aug 2001
- **User Jury XI** - Seventh AAAV(C): Weapon Station & Live Fire Shoot: 23-25 Jan 2002

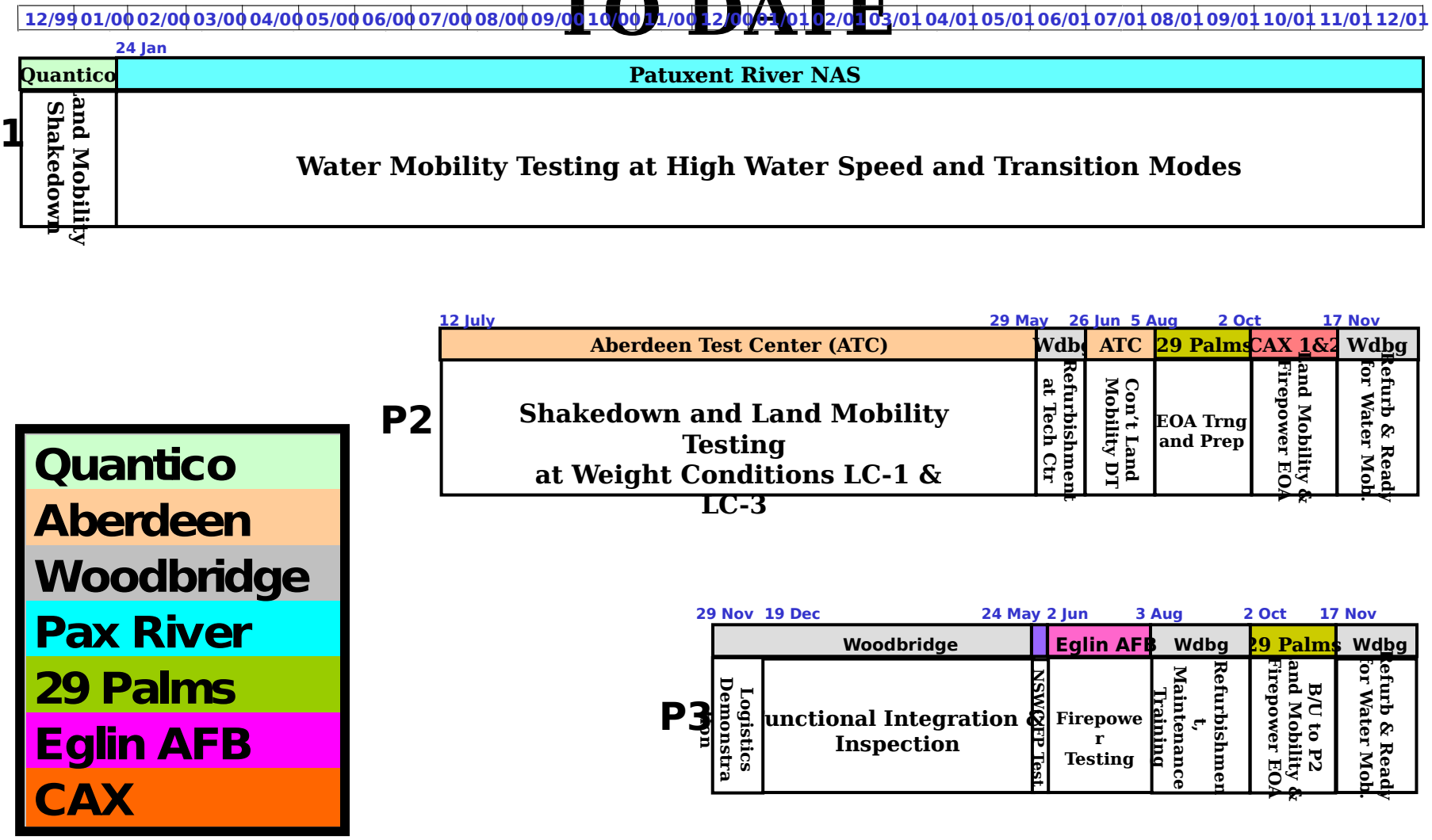
User Juries Provide Early and Invaluable Insight into AAAV Design

FUTURE AAAV(P) & (C) USER JURIES

- **User Jury XII –** Eighth AAAV(C): Mobile Operational Prototype III: Jul 2002
- **User Jury XII –** AAAV(P) & (C): VAPS Display MMI: Aug 2002
- **User Jury XIV –** Ninth AAAV(C): Target C4I Networks: Apr 2003
- **User Jury XV –** AAAV(P): Pre-OA Verification: Oct 2003
- **User Jury XVI –** Tenth AAAV(C): Post OA System Modification Verification: Jun 2005
- **User Jury XVII –** AAAV(P): Post OA System Modification Verification: Oct 2005
- **User Jury XVIII -** Eleventh AAAV(C): Pre IOT&E System Verification: Mar 2006

User Juries Provide Early and Invaluable Insight into AAAV Design

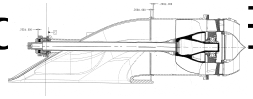
PDRR PROTOTYPE TESTING TO DATE

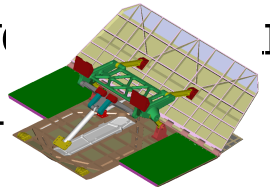


PROTOTYPE #1 TESTING STATUS

- **P1 has 1,913 hours of testing, primarily in High**

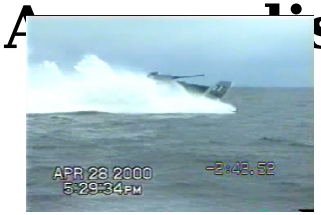
- **Ongoing Developmental Testing Is Characterizing the Hydrodynamic Performance Env nd Optimizing Performanc Handli Characteristics**





SDD Bow

A ishments



Max Speed = 38 Knots

Max Planing Weight 78,600 lbs @ 22 Kts

Transition Mode Fully Characterized

PROTOTYPE #2 TESTING STATUS

- **P2 Has 3,078 Miles of Land Mode Testing**

The Land Speed KPP was Demonstrated

e Carrying KPP was Demonstrated

July 2000

- **Developmental Testing at ATC / 29 Palms has Characterized Land Performance Parameters Such As:**
  - Ride Quality (On / Off Road)
    - Characteristics Are Better Than AAV
  - Steering
  - Max Speed = 73.4 kph
  - Wall Climb = 42 in/(36in LC-3)
  - Gap Cross = 9 ft/(8 ft - LC-3)
  - Approach / Departure Angles
  - Slopes and Grades (50 & 60% LC3 Remain)
  - Braking

PROTOTYPE #3 TESTING STATUS

- **P3 Has 309 Miles of Land Mode and Firepower Testing**

- **To Date, P3 Has Been Used for the Following Tests:**
  - Logistics Demonstration
  - Maintenance/Operator Training for EOA Marines
  - Mk46 System Checkout and Dial-in of Primary and Coax Weapons Systems at Eglin AFB
  - CAX Support

- **While at 29 Palms in Support of EOA, the P3 Prototype Is Also Conducting the Following Developmental Tests:**
  - Engine Cooling System Evaluation (Hot Weather)

FIREPOWER TESTING

- **First Full System Test Conducted at Eglin AFB (June - July 2001)**

  – TP-T ammo: Probability of Hit of 0.90, Stationary to Stationary @ 1500M
  – APFSDS-T: Penetrated armored threat target frontally out to 3000M (max rg tested)
    - **Penetrated armored threat target @ 2300M after ricochet**
  – Optimized Feed System in SDD
  – 7.62MM COAX Demonstrated A

- **Ammunition Testing**

  – Mk44 Gun Qualified Along with
    Types NDI Ammo
  – Demonstrated Capability to Def
    AAAV Target Matrix
    - **Infantry**
    - **MOUT/Bunker Targets**

TEST REPORTS

- Pre-MSII COI Folders: provided to MCOTEA/DOT&E on approximately 80 out of a possible 113 COE evaluation criteria.
- EOA SAR report
- MSII CTP summary - provided as part of the MSII DT Report October 2000 and as part of the SFRT in July 2001
- Armor Validation report
- BH&T test report
- Other Test Reports –issue papers and test reports were attached and/or referenced in the CTP summary provided as part of the DT Report for MSII and as part of the SRFT for the EOA in July 2001
- Land Mobility Report
  - Report covering period Aug 00 - Aug 01
  - DRPM will provide NLT COB.
- Water Mobility Report
  - Original Interim Beginning to Sept 00 for MSII.
  - Next Report Sept 00 to Sept 01 in draft. Expect report to be issued by March 02.
  - Final report will include testing through Dec 01. In progress.

SDD TESTING

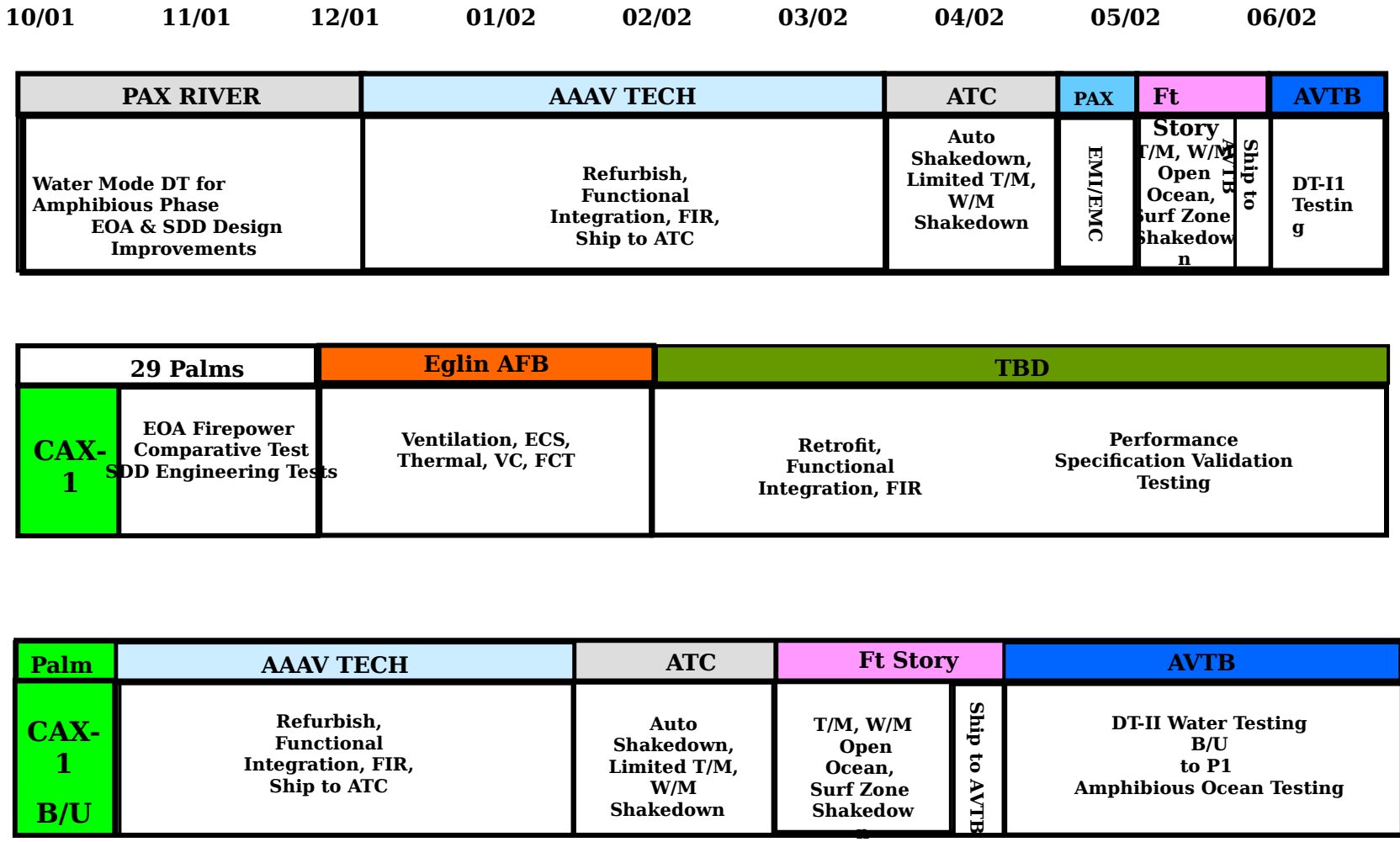
- **Developmental Testing**
  - Land and Water Mobility, Firepower
  - Reliability Testing
- **Operational Testing (Before IOT&E)**
  - Land Mobility Operational Assessment (FY01)
  - Comparative Firepower Operational Assessment (FY02)
  - Amphibious Operations Operational Assessment (FY02)
  - Validating LRIP Entrance Criteria (FY04)
  - SDD Operational Assessment (FY04)
  - Cold Weather Operational Assessment (FY05)

TEST To LEARN

- **Operational Testing**
  - Full Up System Live Fire (FY05)
  - IOT&E (FY06)

TEST To PROVE

FY02 AAAV ASSET UTILIZATION



As of: 18 January 2002

COMPARATIVE FIREPOWER

- AAAV Program Office Objectives:
  - Input on capabilities of the AAAV weapons station design
  - Input on the Marine-Machine Interfaces in the AAAV Turret (gunner, vehicle commander, troop commander)
  - Input on “fightability” of the AAAV
- Other Objectives
  - AAVP7A1 crews will fire the same gunnery matrix as the AAAV(P) prototype for comparison purposes where vehicle Tactics, Techniques, and Procedures allow

AMPHIBIOUS OPERATIONS

- AAAV Program Office Objectives:
  - Input on capabilities of vehicle
    - Operations with Amphibious Shipping
    - Operations in open ocean
    - Operations in the surf zone
  - Input on the Marine-Machine Interfaces in waterborne operations (driver, vehicle commander)
  - Input in ride quality over the water
  - Input on “fightability” of the AAAV in waterborne operations
- Other Objectives
  - Resolve system performance criteria, and to provide comparative AAV/AAAV data where appropriate

Break Time

NEXT GENERATION PROTOTYPE DESIGN IMPROVEMENTS

- **Developmental Testing of the 3 PDRR Prototypes and the BH&T Structure Has Been Successful**
  - Although Some Test Events Were Completed Behind Schedule, Most of the Testing Has Been Completed
  - PDRR Prototype Testing Will Continue Over the Next Year to Focus on Amphibious Operations in the Open Ocean and Surf and Additional Firepower Testing
- **Testing to Date Has Identified Many Design Improvements That Will Be Made to the Next Generation of Prototypes**
  - The Close-to-Objective Design of the PDRR Prototypes Enabled All Aspects of the Vehicle Design to Be Assessed

SDD DESIGN IMPROVEMENT

Troop Space / Comfort

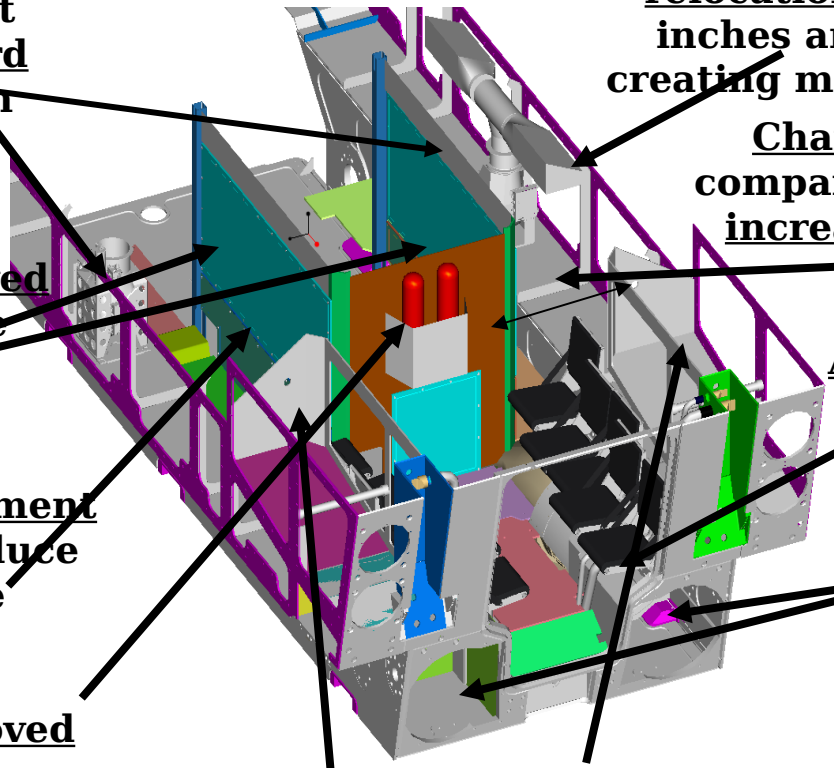
PDRR Prototype Design Issue: Internal Space for Troo

Improvements:

nvironmental Control Unit ort/STBD) moved outboard reating 2-4 more inches in aisleways

Engine compartment lkheads (Port/STBD) moved nboard creating 1-2 more inches in aisleways

Changing engine compartment bulkheads material to reduce bulkhead temperature



Environmental duct redesign and relocation (Port/STBD) up 4 inches and outboard 2-4 in creating more aisleway passage

Chamfered engine and coolant compartment bulkhead (Port/STB increasing aisleway entrance/ex by 3-4 inches

Alternative seat concepts being evaluated

Waterjets Being Moved Aft 6 inches

AFES bottles moved inboard 6-7 inches eliminating aisleways entrance/exit snag points

Radiator compartment forward bulkhead moved AFT 1-2 inches improving aisleway entrance/exit

Reducing snag points and head knockers throughout vehicle

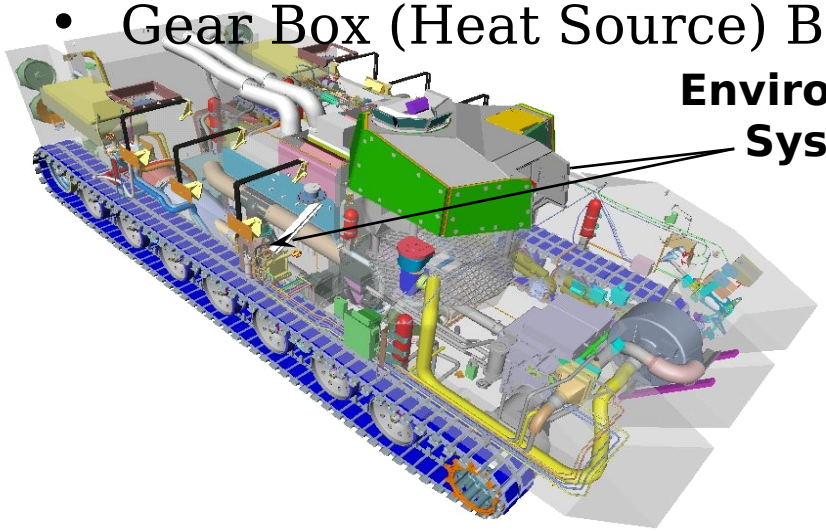
SDD DESIGN IMPROVEMENT

Air Conditioning/Internal Heat

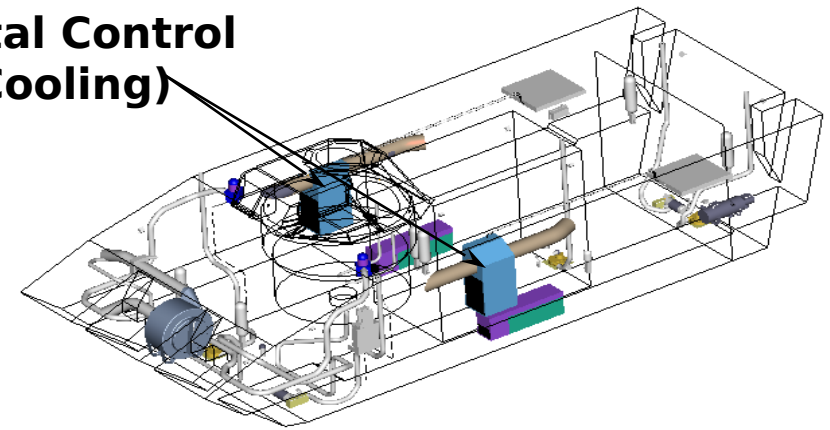
PDRR Prototype Design Issue: High Internal Temperatures/ Inadequate Air-Conditioning

Improvements:

- Environmental Control System (ECS) Being Replaced - New Vendor, Larger Capacity
  - ECS Hydraulic Pumps Being Replaced - Variable Speed
- Hot Components Being Insulated (Engine Compartment, Transmission, etc.)
- Gear Box (Heat Source) Being Isolated From Troop Space



Environmental Control System (Cooling)

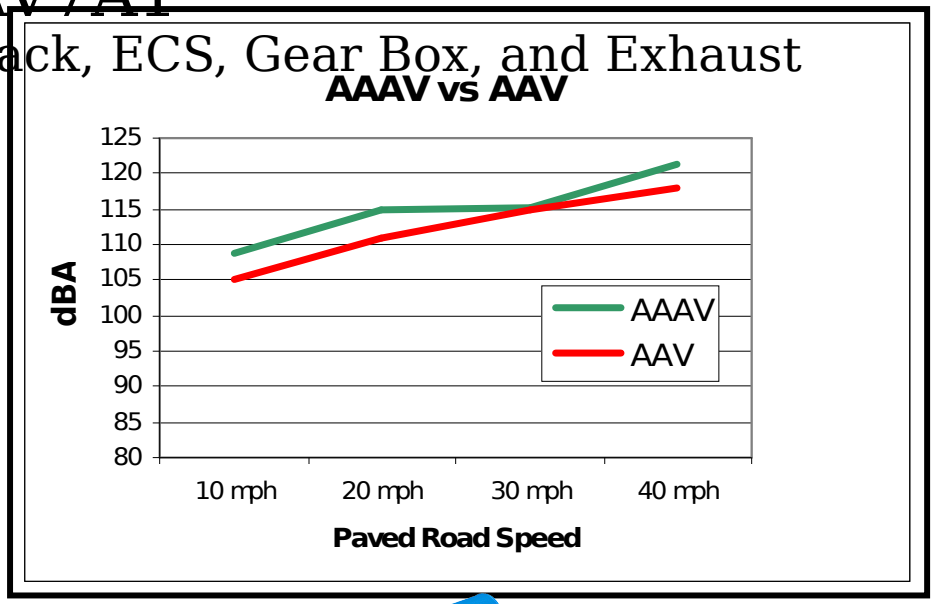


SDD DESIGN IMPROVEMENT

Internal Noise Levels

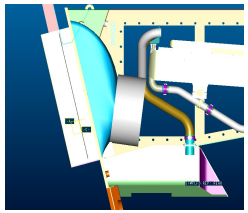
PDRR Prototype Design Issue: Side-by-side Comparisons show that the PDRR Prototypes are Slightly Noisier Than the AAV7A1

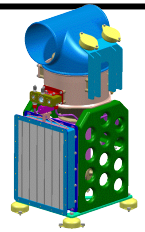
(Noise Sources Include the Track, ECS, Gear Box, and Exhaust Fans)

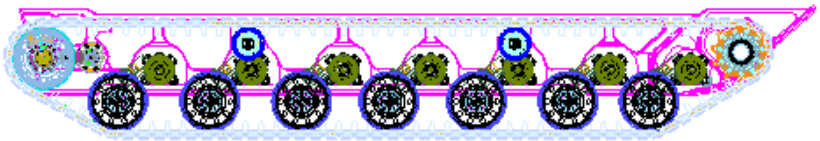


Improvements:

- **The Track Has been Redesigned to use a Quieter Rubber**
- **The ECS is Being Replaced with a New System from a Different Vendor**
- **Gear Box Being Redesigned, Alternate Being Evaluated**
- **The Number of Exhaust Fans is being Reduced from 4 to 2 and the Fans have been Redesigned**







SDD DESIGN IMPROVEMENT

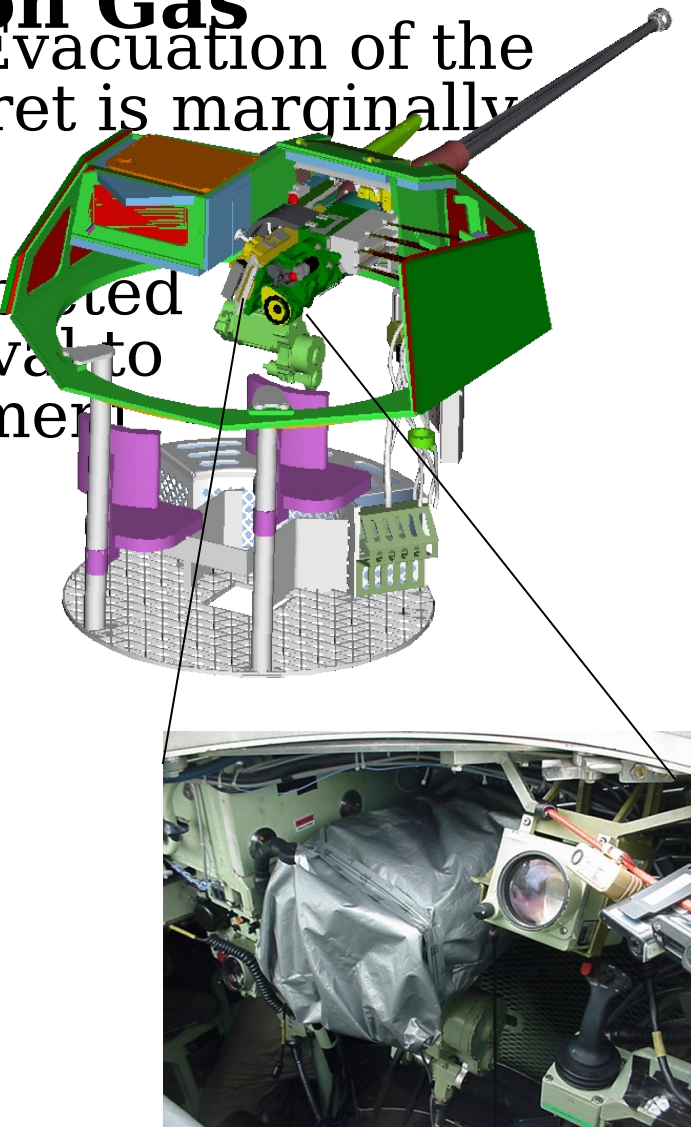
Ammo Combustion Gas Evacuation

PDRR Prototype Design Issue: Evacuation of the Combustion Gas (CO) from the turret is marginally adequate.

Current Activities: Recently completed data collection for MCOTEA approval to enter Gunnery Phase. Data assessment on-going.

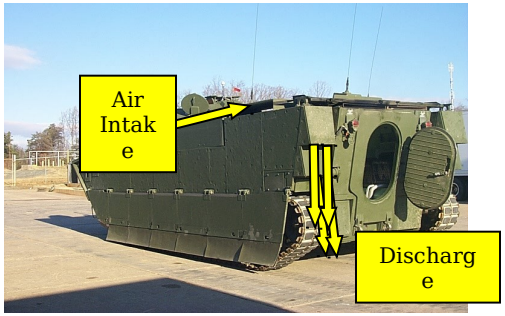
Improvements:

- Hatch Seals Are Being Improved to Ensure Overpressure Performs As Intended
- Improved Engine Compartment seal
- Additional Ventilation is being Provided for the Vehicle Commander
- A Gun Bag Is Being Added to the Mk44 Cannon That Channels the Gas



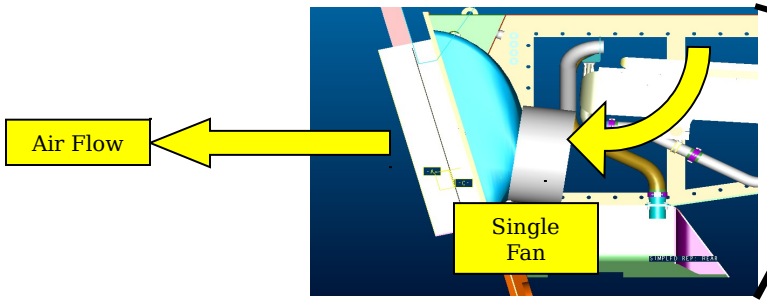
SDD DESIGN IMPROVEMENT
Dust Signature

PDRR Prototype Design Issue: Radiator Exhaust Created a Significant Dust Cloud Behind the Vehicle



Improvements:

- **The Exhaust Fan Flow Is Being Redirected Aft Instead of Directly Down Into the Ground**



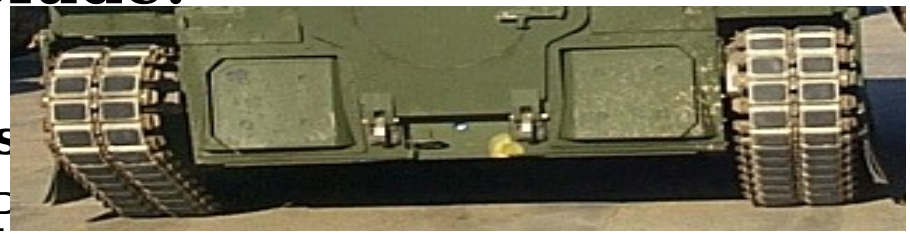
SDD DESIGN IMPROVEMENT

Track System Durability

PDRR Prototype Design Issue: The Prototypes have Experienced Unsatisfactory Instances of Failed Track and Thrown Track

Improvements:

- **Track Idler Assembly and Sprockets are Being Redesigned**
- **Although the PDRR Designed Track Has Proven to be Durable for More Than 3000 Miles of Mixed Terrain, SDD Will Further Refine the Design to Include:**
  - Material Selections
    - **Metals, Rubber, Polymers**
  - Optimizing the Connecting P
    Diameter
  - Optimizing the Bushing Diameter
  - Optimizing the Block Design



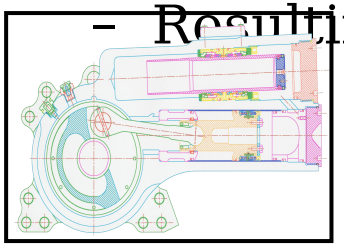
SDD DESIGN IMPROVEMENT

Reliability

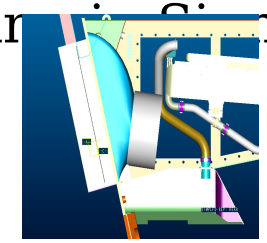
PDRR Prototype Design Issue: PDRR Prototypes Have Lower Than Expected Reliability

Improvements:

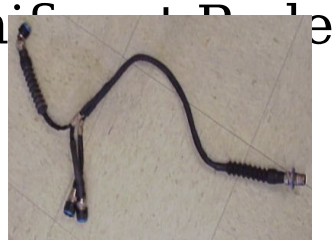
- **All Reliability Drivers Are Being Addressed in the SDD Designs**
  - Resulting in Significant Redesigns That Improve Reliability



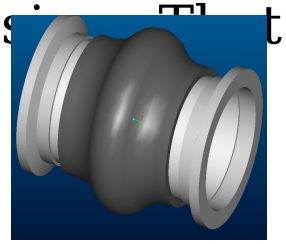
HSUs



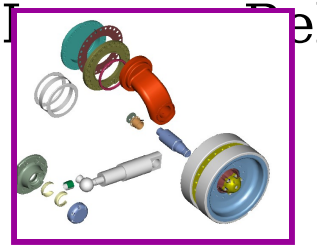
Cooling Fans



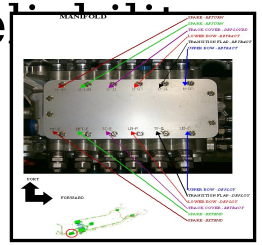
Electrical Cables



Cooling Line Connections



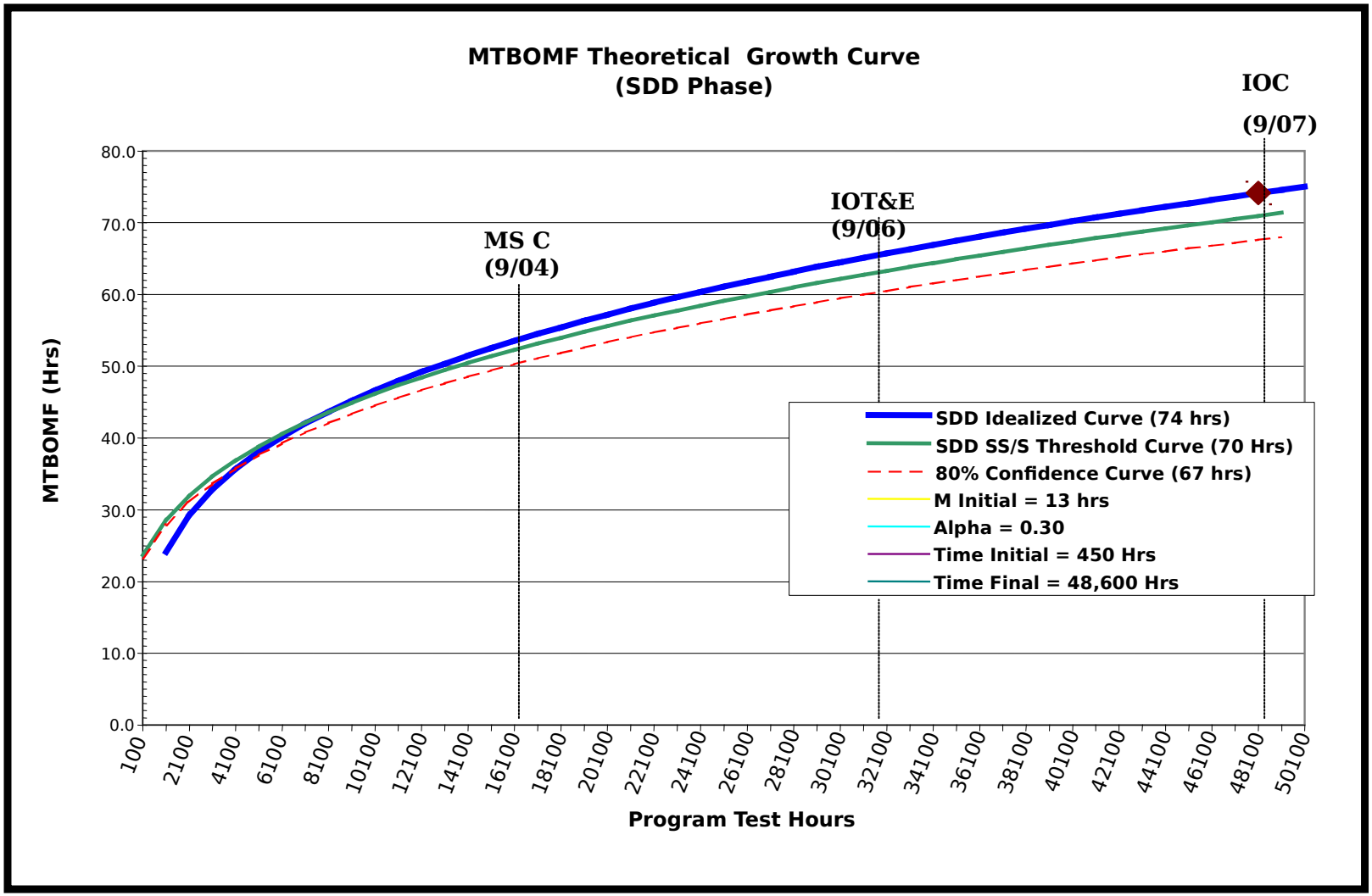
Idler Track Tensioner



Hydraulic Manifolds

  - Program has Implemented a Failure Review Board to Aggressively Pursue or Implement Corrective Action Activity
  - Technical Manuals Will be Far More Mature with the Second Generation Prototypes Reducing Maintenance-

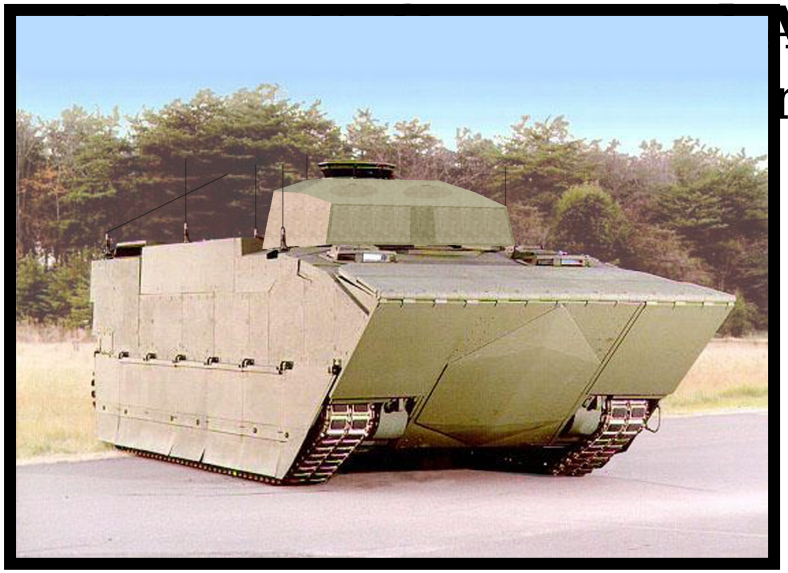
RELIABILITY GROWTH CURVE



Note: The demonstrated reliability will not trace the theoretical curve due to the time delay in implementing corrective actions.

AAAV(C) DEVELOPMENT STATUS

- **AAAV(C) Has Successfully Integrated Required C2 Software Applications.**
- **User Juries Using an AAVC7 Demonstrated the AAAV(C) Workstation Configuration Capable of On-the-move Operations.**
- **AAAV(C) EOA Draft Report States that the AAAV(C) Preliminary Design Has Sufficient Access mmand**



AAAV(C) TEST ACTIVITY

- CMOP completed in Aug 01
  - Demonstrated data-link over RF
- Contractor testing of linked co-site boxes successful
- Letter sent to AFATDS program office identifying integration issues and recommended changes
- Cupola / 7.62mm weapon mount test conducted at Quantico
  - DT Marines evaluated competing designs and recommended improvements

C4I TEST ACTIVITY

- Antennas/Intercom/SINCGARS performed well during (P) EOA.
- High-water speed Satcom link closed successfully
- Contractor testing of new co-site box successful
- Contractor testing of Rack shock and vibe successful
  - Possible use of lighter coil shock isolator
- C2PC requirements identified to Project Office
  - Recently began work on 2 AAAV funded requirements.
- Testing to determine minimum C2PC hardware requirements.
- EMI testing scheduled at Pax River for two vehicles
  - Data to support Amphibious EOA safe & ready.

Break Time?

AAAV Live Fire Test and Evaluation IPT

W T&E IPT Briefing

Derek Erdley
AAAV DRPM – Survivability
6 February 2002

Philosophy

- Provide strategy and leadership for comprehensive evaluation of AAAV vulnerability
- Building block process for evaluation
- Testing supplemented with modeling and simulation effort
- Leveraging each preceding phase to provide comprehensive evaluation of the potential susceptibilities and vulnerabilities at the earliest phase of the development life cycle
- Provide an assessment of vulnerability, vulnerability reduction, and lethality of both P and C variants
- Affect the design

LFT&E IPT Accomplishments

- BH&T completed
  - 34 Shots completed December 00 through June 01
  - Follow on AFES testing in Feb 02
- LFT&E IPT met last on 22 January, next meeting 14 February
- TEMP Strategy update distributed to LFT&E IPT for review
  - Updated test plans & matrices based on program schedule change
- MCOTEA will become new chair of IPT

Summary of Current LFT&E Plan

- <u>Armor Characterization Tests</u>
  - Purpose:BAD, BDAR and environmental cycling
  - Scope: 100 targets, 500 shots
  - Schedule:1st QFY03 – 3rd QFY03

- <u>Ballistic Vulnerability Tests</u>
  - Purpose: BDAR and functional performance
  - Scope: 14 Shots
  - Schedule: 1st QFY03 – 4th QFY03

Summary of Current LFT&E Plan

- Component Ballistic Tests
  - Purpose: Vulnerable component performance with selected threats
  - Scope: 9 shots
  - Schedule: 3rd QFY02
- Controlled Damage Tests (P Variant)
  - Purpose: Evaluate synergistic and cascading damage
  - Scope: Multiple events
  - Schedule: 1st – 2nd QFY03; 1st QFY05
- Controlled Damage Tests (C Variant)
  - Schedule: TBD

Summary of Current LFT&E Plan

- <u>FUSL Tests</u>
  - Purpose: Evaluate production representative EMD AAAV (P) Vehicle
  - Scope: 16 shots (Investigating number of test assets)
  - Schedule: 1st QFY05 – 1st QFY07

Summary of Current LFT&E Plan

- Modeling and Simulation
  - Key elements:
    - Preshot predictions
    - Full system assessment
  - Purpose:
    - Vulnerability estimates for threats and conditions not tested
  - Responsibilities and schedules established for:
    - VV&A plan
    - Modeling plan
      - Target geometry
      - Component P_ks
      - Damage Assessment List
      - Criticality Analysis

BH&T Overview

- **Purpose:**
  - Identification of areas requiring redesign
  - Armor performance/response
  - Structural response to ballistic events
  - Characterization of damage to support BDAR development
  - Shock propagation characteristics of design
  - Response of critical seals and alignments
- **Test Approach:**
  - Phase I - Water environment testing at AEC Underwater Explosion (UNDEX) Test Facility (3 shots)
  - Phase II - 31 land based events, range of threats from small arms to large KE, shaped charges and artillery,

- **Test Configuration:**
  - BH&T up weighted to operational weight
  - Anthropomorphic manikins installed for some shots
  - Critical components (HSU,full suspension, fuel cells, etc.) installed for some
  - Instrumented for :
    - Acceleration and Strain
    - Toxic Fumes
    - Temperature
    - Pressure

- **SDD design reflects lessons learned**
- **AFES test being conducted as follow on**

OPERATIONAL ASSESSMENTS

PDRR AAAV(P) PROTOTYPE

- **EOA for Land Mobility was Independently Conducted by MCOTEA**
- **EOA Conducted Across CAX Scenario -**
  - **29 Palms - Oct/Nov 01**
- **4 Major Operational Events**
- **Unit Involved: 3/5 (K Company)**
  - AAAV Unit Operator and Maintainer Training
  - Mobile Assault Course with Infantry Company
  - Mobile Assault Course with Tank Company
  - FINEX - Maneuver of the Marine Ground Combat Element, both offensive and defensive tactics, Performance is Evaluated
- **AAAV/AAV Comparative Firepower Event Planned for 2nd QTR FY02**

MCOTEA BRIEF

TEMP UPDATE TIMELINE

- Parts 1, 2, 3 draft distributed today and DT portion of Historical Appendix.
- Work Part 4 issues with MCOTEA.
- LFT&E IPT processing Live-Fire strategy and Issues.
- Discussion Points:

Recap of Action Items